CLAIMS

1. A method of reducing an amount of carbon monoxide in process fuel gas in a water gas shift converter, comprising:

placing a high activity water gas shift catalyst system into a water gas shift converter, the high activity water gas shift catalyst system comprising a noble metal; a support consisting essentially of cerium oxide, or a mixed metal oxide of cerium oxide-zirconium oxide wherein cerium oxide is present in an amount ranging from about 80% to about 20% by weight of total metal oxide and wherein zirconium oxide is present in an amount ranging from about 20% to about 80% by weight of total metal oxide, or a mixed metal oxide of cerium oxide-lanthanum oxide wherein cerium oxide is present in an amount ranging from about 80% to about 20% by weight of total metal oxide and wherein lanthanum oxide is present in an amount ranging from about 20% to about 80% by weight of total metal oxide; an anti-methanation agent comprising at least one compound selected from copper compounds, manganese compounds, iron compounds, or combinations thereof; and optionally a promoter comprising at least one metal selected from alkali metals or alkaline earth metals; and

passing the process fuel gas through the water gas shift converter in effective contact with the high activity water gas shift catalyst system and converting a portion of the carbon monoxide in the process fuel gas into carbon dioxide and hydrogen by a water gas shift reaction with no methane formation at a temperature in a range of about 200°C to about 350°C.

2. The method of claim 1 wherein the anti-methanation agent comprises a copper compound in an amount ranging from about 0.1% to about 10% by total weight of catalyst.

3. The method of claim 1 wherein the anti-methanation agent comprises a manganese compound in an amount ranging from about 0.1% to about 5% by total weight of catalyst.

4. The method of claim 1 wherein the anti-methanation agent comprises an iron compound in an amount ranging from about 0.1% to about 5% by total weight of catalyst.

5. The method of claim 1 wherein the noble metal is selected from platinum, palladium, ruthenium, iridium, or mixtures thereof.

6. The method of claim 1 wherein the noble metal is present in an amount ranging from about 1% to about 4% by weight of total catalyst.

7. The method of claim 1 wherein the promoter is selected from cesium, lithium, rubidium, potassium, magnesium, strontium, barium, or combinations thereof.

8. The method of claim 1 wherein the promoter is present in an amount of between about 0.1% and about 1% by weight of total catalyst.

9. The method of claim 1 wherein there is no methane formation at a temperature in a range of about 200°C to about 425°C.

10. The method of claim 1 wherein there is no methane formation at a temperature in a range of about 200°C to about 500°C.

11. The method of claim 1 wherein there is no methane formation at a temperature in a range of about 200°C to about 600°C.

12. The method of claim 1 wherein passing the process fuel gas through the water gas shift converter is performed at a temperature in the range of about 200°C to about 475°C.

13. The method of claim 1 wherein passing the process fuel gas through the water gas shift converter is performed at a temperature in the range of about 250°C to about 425°C.

14. A method of reducing an amount of carbon monoxide in process fuel gas in a water gas shift converter, comprising:

placing a high activity water gas shift catalyst system into a water gas shift converter, the high activity water gas shift catalyst system comprising a noble metal; a support consisting essentially of cerium oxide, or a mixed metal oxide of cerium oxide-zirconium oxide wherein cerium oxide is present in an amount ranging from about 80% to about 20% by weight of total metal oxide and wherein zirconium oxide is present in an amount ranging from about 20% to about 80% by weight of total metal oxide, or a mixed

metal oxide of cerium oxide-lanthanum oxide wherein cerium oxide is present in an amount ranging from about 80% to about 20% by weight of total metal oxide and wherein lanthanum oxide is present in an amount ranging from about 20% to about 80% by weight of total metal oxide; an anti-methanation agent comprising at least one compound selected from copper compounds present in an amount ranging from about 0.1% to about 10% by total weight of catalyst, manganese compounds present in an amount ranging from about 0.1% to about 5% by total weight of catalyst, iron compounds in an amount ranging from about 0.1% to about 5% by total weight of catalyst, or combinations thereof; and a promoter comprising at least one metal selected from alkali metals or alkaline earth metals, the promoter present in an amount ranging from about 0.1% to about 1% by weight of total catalyst; and

passing the process fuel gas through the water gas shift converter in effective contact with the high activity water gas shift catalyst system and converting a portion of the carbon monoxide in the process fuel gas into carbon dioxide and hydrogen by a water gas shift reaction with no methane formation at a temperature in a range of about 200°C to about 350°C.

15. A high activity water gas shift catalyst system comprising:

a noble metal;

a support consisting essentially of cerium oxide, or a mixed metal oxide of cerium oxide-zirconium oxide wherein cerium oxide is present in an amount ranging from about 80% to about 20% by weight of total metal oxide and wherein zirconium oxide is present in an amount ranging from about 20% to about 80% by weight of total metal oxide, or a

mixed metal oxide of cerium oxide-lanthanum oxide wherein cerium oxide is present in an amount ranging from about 80% to about 20% by weight of total metal oxide and wherein lanthanum oxide is present in an amount ranging from about 20% to about 80% by weight of total metal oxide;

an anti-methanation agent comprising at least one compound selected from copper compounds, manganese compounds, iron compounds, or combinations thereof; and

optionally a promoter comprising at least one metal selected from alkali metals or alkaline earth metals,

wherein the high activity water gas shift catalyst system has no methane formation at a temperature in a range of about 200°C to about 350°C.

16. The high activity water gas shift catalyst system of claim 15 wherein the anti-methanation agent comprises a copper compound in an amount ranging from about 0.1% to about 10% by total weight of catalyst.

17. The high activity water gas shift catalyst system of claim 15 wherein the anti-methanation agent comprises a manganese compound in an amount ranging from about 0.1% to about 5% by total weight of catalyst.

18. The high activity water gas shift catalyst system of claim 15 wherein the anti-methanation agent comprises an iron compound in an amount ranging from about 0.1% to about 5% by total weight of catalyst.

19. The high activity water gas shift catalyst system of claim 15 wherein the noble metal is selected from platinum, palladium, ruthenium, iridium, or mixtures thereof.

20. The high activity water gas shift catalyst system of claim 19 wherein the noble metal is present in an amount ranging from about 1% to about 4% by weight of total catalyst.

21. The high activity water gas shift catalyst system of claim 15 wherein the promoter is selected from cesium, lithium, rubidium, potassium, magnesium, strontium, barium, or combinations thereof.

22. The high activity water gas shift catalyst system of claim 15 wherein the promoter is present in an amount of between about 0.1% and about 1% by weight of total catalyst.

23. The high activity water gas shift catalyst system of claim 15 wherein there is no methane formation at a temperature in a range of about 200°C to about 425°C.

24. The high activity water gas shift catalyst system of claim 15 wherein there is no methane formation at a temperature in a range of about 200°C to about 500°C.

25. The high activity water gas shift catalyst system of claim 15 wherein the high activity water gas shift catalyst system has no methane formation at a temperature in a range of about 200°C to about 600°C.

26. A method of reducing an amount of carbon monoxide in process fuel gas in a water gas shift converter, comprising:

placing a high activity water gas shift catalyst system into a water gas shift converter, the high activity water gas shift catalyst system comprising a support consisting essentially of a mixed metaloxide of cerium oxide-copper oxide wherein cerium oxide is present in an amount ranging from about 80% to about 50% by weight of mixed metal oxide, and wherein copper oxide is present in an amount ranging from about 20% to about 50% by weight of mixed metal oxide, or a mixed metal oxide of zirconium oxide-copper oxide wherein zirconium oxide is present in an amount ranging from about 80% to about 50% by weight of mixed metal oxide, and copper oxide is present in an amount ranging from about 20% to about 50% by weight of mixed metal oxide; optionally a noble metal; and optionally a promoter comprising at least one metal selected from alkali metals and alkaline earth metals; and

passing the process fuel gas through the water gas shift converter in effective contact with the high activity water gas shift catalyst system and converting a portion of the carbon monoxide in the process fuel gas into carbon dioxide and hydrogen by a water gas shift reaction with no methane formation at a temperature in a range of about 200°C to about 350°C.

27. The method of claim 26 wherein the promoter is selected from cesium, lithium, rubidium, potassium, magnesium, strontium, barium, or combinations thereof.

28. The method of claim 26 wherein the promoter is present in an amount ranging from about 0.1% and about 1% by weight of total catalyst.

29. The method of claim 26 wherein passing the process fuel gas through the water gas shift converter is performed at a temperature in the range of about 200°C to about 475°C.

30. The method of claim 26 wherein passing the process fuel gas through the water gas shift converter is performed at a temperature in the range of about 250°C to about 425°C.

31. The method of claim 26 wherein there is no methane formation at a temperature in a range of about 200°C to about 425°C.

32. The method of claim 26 wherein there is no methane formation at a temperature in a range of about 200°C to about 500°C.

33. The method of claim 26 wherein there no methane formation at a temperature in a range of about 200°C to about 600°C.

34. The method of claim 26 wherein the noble metal is selected from platinum, palladium, ruthenium, iridium, or mixtures thereof.

35. The method of claim 26 wherein the noble metal is present in an amount ranging from about 1% to about 4% by weight of total catalyst.

36. A method of reducing an amount of carbon monoxide in process fuel gas in a water gas shift converter, comprising:

placing a high activity water gas shift catalyst system into a water gas shift converter, the high activity water gas shift catalyst system comprising a support consisting essentially of a mixed metal oxide of cerium oxide-copper oxide wherein cerium oxide is present in an amount ranging from about 80% to about 50% by weight of mixed metal oxide, and wherein copper oxide is present in an amount ranging from about 20% to about 50% by weight of mixed metal oxide, or a mixed metal oxide of zirconium oxide-copper oxide wherein zirconium oxide is present in an amount ranging from about 80% to about 50% by weight of mixed metal oxide, and copper oxide is present in an amount ranging from about 20% to about 50% by weight of mixed metal oxide; optionally a noble metal; and a promoter comprising at least one metal selected from alkali metals and alkaline earth metals, the promoter present in an amount ranging from about 0.1% to about 1% be total weight of catalyst; and

passing the process fuel gas through the water gas shift converter in effective contact with the high activity water gas shift catalyst system and converting a portion of the carbon monoxide in the process fuel gas into carbon dioxide and hydrogen by a water gas shift reaction with no methane formation at a temperature in a range of about 200°C to about 350°C.

37. A high activity water gas shift catalyst system comprising:

a support consisting essentially of a mixed metal oxide of cerium oxide-copper oxide wherein cerium oxide is present in an amount ranging from about 80% to about 50% by weight of mixed metal oxide, and wherein copper oxide is present in an amount ranging from about 20% to about 50% by weight of mixed metal oxide, or a mixed metal oxide of zirconium oxide-copper oxide wherein zirconium oxide is present in an amount ranging from about 80% to about 50% by weight of mixed metal oxide, and copper oxide is present in an amount ranging from about 20% to about 50% by weight of mixed metal oxide;

optionally a noble metal; and

optionally a promoter comprising at least one metal selected from alkali metals and alkaline earth metals,

wherein the high activity water gas shift catalyst system has no methane formation at a temperature in a range of about 200°C to about 350°C.

38. The high activity water gas shift catalyst system of claim 37 wherein the noble metal is selected from platinum, palladium, ruthenium, iridium, or mixtures thereof.

39. The high activity water gas shift catalyst system of claim 37 wherein the noble metal is present in an amount ranging from about 1% to about 4% by weight of total catalyst.

40. The high activity water gas shift catalyst system of claim 37 wherein the promoter is selected from cesium, lithium, rubidium, potassium, magnesium, strontium, barium, or combinations thereof.

41. The high activity water gas shift catalyst system of claim 37 wherein the promoter is present in an amount of between about 0.1% and about 1% by weight of total catalyst.

42. The high activity water gas shift catalyst system of claim 37 wherein there is no methane formation at a temperature in a range of about 200°C to about 425°C.

43. The high activity water gas shift catalyst system of claim 37 wherein there is no methane formation at a temperature in a range of about 200°C to about 500°C.

44. The high activity water gas shift catalyst system of claim 37 wherein the high activity water gas shift catalyst system has no methane formation at a temperature in a range of about 200°C to about 600°C.